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Możliwość rozwoju kompetencji informatycznych w przedmiocie technicznym

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THE POSSIBILITY OF DEVELOPING DIGITAL COMPETENCIES IN THE TECHNICAL SUBJECT

Abstract

We deal with the summary of essential characteristics of key competences, which are the fundamental elements of the State educational programs. The aim was to analyze an example of usage of a digital competence in Technology and to draw attention to its function as a tool to develop knowledge, skills and creativity of students. In the empiric part we adverted to a pedagogical experiment which proves that a computer significantly influences not only the efficiency of students during teaching but also their motivational effect during the lessons.

MOŻLIWOŚĆ ROZWOJU KOMPETENCJI INFORMATYCZNYCH W PRZEDMIOCIE TECHNICZNYM

Streszczenie

Zajęliśmy się podsumowaniem podstawowych cech kluczowych kompetencji, które są fundamentalnymi elementami państwowych programów edukacyjnych. Celem artykułu jest zbadanie przykładu wykorzystania kompetencji cyfrowych w Technologii i zwrócenie uwagi na jego funkcję jako narzędzia rozwijania wiedzy, umiejętności i kreatywności uczniów. W części empirycznej zamieściliśmy eksperyment pedagogiczny, który ma na celu udowodnienie, że komputer ma znaczący wpływ nie tylko na wydajność uczniów w nauce, ale także efekt motywacyjny podczas lekcji.

Introduction

In the spirit of current trends concerning development of technology and knowledge about effective education, teachers of natural science subjects aim to use computers during lessons and develop their digital competences that way. They are trying to create MTA which would fulfill the conception of creative humanistic teaching approach in subjects where computers serve as a means of the teaching process. Teaching with the use of multimedia helps to develop in individuals such abilities, skills and competences, which help to cope with fast changes in personal and social life. They will help him in a range of unpredictable problems.

Digital competence and teaching process

There are only a few competences that students acquire based on their own effort and whose development they even prefer. Among these belongs digital competence, i.e.

awareness to use digital technologies and working with information. Acquiring this competence along with communication competences represents an important element of formal and informal education. Developing technologies such as computers, the Internet and its services (chat, social networks, e-mail, and video conferences), mobile telephones, digital cameras etc., participate on developing digital competence.

Under digital competence we understand the ability of pupils to:

- Search for and evaluate information – pupils should not only be able to look for information but also to asses their reliability, validity, possibilities of distorting data and information sources, choose information relevant for solving a certain task when considering their origin and quality. Pupils should be able to obtain and collect information, process the acquired data, draw conclusions and answer hypotheses.
- Process information – pupils should be able to use digital technologies to analyze, process and present information, they should know that they can use models and modelling for demonstration of a situation and a process on the screen, to analyze equations and relations based on a change of variables and use this possibility.
- Share and exchange information – it is connected with communication, pupils should know different ways and conventions which are used during communication and use this knowledge for a suitable presentation of information taking into consideration the audience. (Nationalstrategies, 2009).

Digital competence includes self-confident and critical use of technologies of the information society for work purposes, in free time and for communication. It is based on basic skills in ICT. Using a computer to obtain, asses, save, create, present and exchange information and to communicate and participate in cooperating networks using the Internet.

Digital competence requires full understanding and knowledge about the character, task and opportunities of technologies of the information society in everyday context, in personal and social life and at work. These include main computer applications like word and spreadsheet processor, databases, saving and managing information and understanding opportunities and possible risks, which are concerned with the Internet and communication via electronic media (electronic post, network tools) at work, in free time, to share information, to cooperate on the network, for education and research. Individuals should also understand how technologies of a communication company support creativity and innovations and should also be aware of the issue connected with validity and reliability of accessible information and of legal and ethical principles of interactive use of technologies of the information society. The necessary skills include ability to look for, collect and process information and to use it in a critical and systematic way, to asses its relevance and to distinguish between reality and virtual world and at the same time identify connections. Individuals should be able to use the tools for creating, presentation and understanding difficult information and to make accessible, to look for and use services created on the Internet. Individuals should also be able to use technologies of information society to support critical thinking, creativity and innovation.

Digital competence in teaching Technology

For each subject of a curriculum in our schools abilities have been defined, which should primarily be developed in a certain subject concerning the content and character of the subject. By an intersection of all subjects we can naturally develop all aspects of digital competence of a student. In natural science subjects it is important to assign students with such tasks which will make them search, asses, choose, analyze, process and present information.

Technology as a natural science and experimental subject, literally offers itself to a complex use of digital technologies. Their significant advantage when compared to traditional teaching means is their visualization, simulation, active intervention, interactivity, instant feedback, decision making strategies, motivation. How can a teacher of Technology catch the attention of a present day student? Digital technologies offer a solution, which significantly support object and interactive teaching while still allow the teacher to apply innovative teaching strategies more effectively. These strategies primarily are:

- group work and cooperative teaching - develops social skills, ability to cooperate, to share work, and take the responsibility for it,
- integrated teaching - builds an integrated view at natural phenomenon,
- project teaching - develops a variety of skills of a student during a complex processing of an assigned task,
- problem teaching - develop the ability to think critically and creatively.

Applying digital technologies and developing key competences of students on the Technology lessons require direct interference into the organization of teaching and into the teacher’s work. The most serious step is adjustment of curriculum in such a way that it would offer enough space not only to use digital technologies but also to create space to discover knowledge, to solve problem tasks and situations, for project work and other outputs (3D tools, simple animations, quiz, etc.) which would be created by students. Sophisticated work with a textbook and a scientific text (reading comprehension, learning from a text, orientation in a text, classification, using essential information), individual search, examination, discovering represent a didactically effective way.

From the point of view of developing digital competence and basic competence in the filed of science an technology it is necessary to conduct observation and experiments with the support of digital technologies on the classes of practical exercises. The method of observation and experiment is mostly used only to consolidate and confirm already obtained knowledge of students. While solving problem tasks and situations it is necessary for students to search for, critically asses and choose information while taking into consideration its relevance and credibility of the information sources.

Growing accessibility of computers in education allows students to analyze a problem and validate its result using real school experiments. Another value added to conducting e.g. school experiments in computer supported laboratories is the possibility to apply in students' work the basic principles of scientific research and that way simulate working conditions of scientists.

Digital microscope shows the field of vision on a computer screen. Visualization of abstract technical terms for students offers space for discussion, interaction and active participation of students in the construction of their own knowledge. It allows mutual problem solving and cooperation of students.

Modern digital technologies support mobility and possibility to organize teaching or its parts directly in the field. Students have an opportunity to collect information in the field and process them subsequently in the class or in a workroom. Mobile Internet accessibility enables on-line communication between the field and the class.

Subject, Aims and Hypotheses of the Research

The level of acquiring digital competences can be measured. Standards of basic digital competences are exceptionally well laid out. The best known for the public, the most spread in teaching and the most respected among employers of the labor market in the EU is the standard of digital competences defined by the syllabus ECDL (European Computer Driving License). The aim is to increase the level of IT knowledge and the level of competences in using personal computers and basic computer applications.

The basis of our pedagogical research was laid on the questions whether students acquire better results and stronger motivation during classes where a computer is used (MTA), than during classes where the teacher uses other (traditional) methods:

The research questions:

- *Do the students taught with the use of a computer acquire **better results** than those who are taught by traditional methods?*
- *Do the students have **stronger motivation** during classes where a computer is used than during those where the teacher uses other traditional methods?*

From the above mentioned research questions we have formed the following underlying hypothesis:

We suppose that: **applying and using elements of MTA during teaching in an experimental class of Technology the level of cognitive area and motivational influence on lessons is statistically significantly more influenced than in the control class.**

To support or invalidate the underlying hypothesis, we have divided it into more partial hypotheses:

Hypothesis 1: **Motivational influence of a teacher on students will be significantly stronger in those groups in which the teacher uses MTA, than in those where he does not.**

Research Sample

The basic set, suitable for our research, were pupils of the 7th year of the 2nd level of primary schools in the Slovak Republic. We can consider the results of the population of pupils of the 7th year in the Slovak Republic to be normally distributed. That is why we can process data as a selection of the normal distribution in the research. In terms of external validity of the research, we performed the sampling selection by the stratified selection. The sample was made of 104 pupils of the 7th year from five primary schools in the Slovak Republic. To be able to objectively determine whether our MTA (independent variable) affects the level of knowledge of road safety education of pupils of the 7th year of primary schools in Technical Education, we included two groups of respondents in the experiment: the control group and the experimental group. The control and experimental groups were always formed by the entire class. The control group consisted of 52 pupils. 52 pupils were also in the experimental group. We purposefully marked all control subgroups as one control group CON and all the experimental subgroups are identified as one experimental group EXP.

Table 1. The Overall Summary of the Selection of Pupils into Groups in the Educational Research

Number of selected classes of the 7th year of the 2nd level of primary schools	6	104 pupils
Number of groups taking part in the educational research	2	CONTROL and EXPERIMENTAL
Number of experimental subgroups	5	a given number of pupils in every subgroup
Number of control subgroups	3	a given number of pupils in every subgroup
Experimental group EXP ● experimental subgroup A1 ● experimental subgroup A2 ● experimental subgroup A3	**52 pupils** pupils21 pupils20 pupils11	
Control group CON ● control subgroup B1 ● control subgroup B2 ● control subgroup B3	**52 pupils** Pupils21 pupils23 pupils8	

Statistical processing and analysis of the collected data

We have obtained the motivation stimuli, which affected students of the control and experimental group, by post measuring with the use of a research tool (an MTA questionnaire). Statistical description of a dependent MOT variable is indicated in the tables 2 and 3.

Table 2. Statistical description of a dependent variable **MOT in experimental group**

Variable	Number of rate	arithmetic mean	Interval of credibility +95%		Median	Modus	Number of modi	Minimum	Maximum	Var. range	Dispersion	Standard deviation	Standard deviation of arithmetic mean
Freedom	52	17,244	16,778	17,312	17	more		14	20	6	2,49093	1,58971	0,56982
Success	52	17,263	16,706	17,795	17	17	8	14	20	6	2,25697	1,56898	0,45123
Acknowledgement	52	17,230	16,761	17,863	17	17	7	14	20	6	2,56898	1,56987	0,14783
Communication	52	17,291	16,665	17,835	17	17	7	14	20	6	2,69869	1,69854	0,36952
Thinking	52	16,261	15,369	16,321	16	16	7	13	20	7	2,26596	1,54789	0,15698
MTA	**52**	**17,069**	**16,746**	**17,312**	**17,1**	**17,2**	6	**15,8**	**19,2**	**3,4**	**0,47896**	**0,89653**	**0,15269**

Table 3**.** Statistical description of a dependent variable **MOT in control group**

Variable	Number of rate	arithmetic mean	Interval of credibility +95%		Median	Modus	Number of modi	Minimum	Maximum	Var. range	Dispersion	Standard deviation	Standard deviation of arithmetic mean
Freedom	52	10,250	9,709	10,792	10	more		7	20	6	2,49093	1,58971	0,56982
Success	52	10,756	11,364	13,555	14	more		8	20	6	2,25697	1,56898	0,45123
Acknowledgement	52	10,719	11,556	12,953	13	17	7	8	20	6	2,56898	1,56987	0,14783
Communication	52	12,126	11,742	13,356	12	13	7	14	20	6	2,69869	1,69854	0,36952
Thinking	52	12,313	12,698	13,059	12	11	7	13	20	7	2,26596	1,54789	0,15698
MTA	**52**	**12,056**	**11,656**	**12,365**	**11,1**	**1,2**	5	**10,8**	**14,2**	**4**	**1,09996**	**1,09456**	**0,18963**

Medium rate of the score of the MOT variable in both tables points at differences in the ratio of the motivational inputs between the control and experimental group. The observation implies that students have reviewed motivational effect of teaching methods in different qualitative intervals in all groups (Freedom, Success, Acknowledgement, Communication, Thinking). The maximum rate in the control group does not reach the minimum rate in the experimental group.

Chi² test affirmed the zero statistical hypothesis of the division consistency. We state that the observed division **of comparative multitude of the MOT variable in both groups (experimental and control) corresponds with a very good** ($p>0,8$), adjustment to the normal division. Calculated rates $Chi^2_{exp}=3,5986$ and $Chi^2_{kont}=0,5698$ are markedly below critical rates. All hypotheses were examined on the significance level $\alpha=0,05$.

Since all variables have normal division, it is possible by inductive statistics to use parametric testing methods.

After conducting six parametric tests, t-tests for variables (Freedom, Success, Acknowledgement, Communication, Thinking and MOT variable) we observe that the research assumption about differences in the motivational effect has been confirmed by measurements and analyses. Summary of the outputs is shown in table 4.

T-test confirmed that arithmetical diameter clearance of the total score and the score from five different areas of the dependent MOT variable was not random but statistically significant (p-rate □□0,001). The zero statistical hypothesis between motivational effect of the teacher of the control and experimental group shows no variation, therefore we have rejected $ap_{ex}=ap_{ko}$ and we have accepted an alternative hypothesis ($ap_{ex}>ap_{ko}$).

Table 4. T-testsof the MOT variable

	Freedom	**Success**	**Acknowledge**	**Communicatio**	**Thinking**	**Absolute MOT**
Arit. mean (experimental)	17,23	17,35	17,69	17,26	16,65	17,69
Arit. mean (control)	10,21	11,23	12,32	12,69	12,45	12,45
Calculated t-rate	**18,42365**	**8,45698**	**12,56984**	**10,15466**	**8,45263**	**20,45228**
Number of variance	62					
Importance	**sig.**	**sig.**	**sig.**	**sig.**	**sig.**	**Sig.**
P	p□□0,001	p□□0,001	p□□0,001	p□□0,001	p□□0,001	p□□0,001
Supporting calculations for t.test						
Valid rates (experimental)	32					
Valid rates (control)	32					
Standard deviation (exper.)	1,5469366	1,569867	1,2365474	1,632548	1,123546	0,869532
Standard deviation (control)	1,5021365	2,451278	1,6541236	1,451136	2,124569	1,1245
F-ratio of dispersion	1,4521363	2,455123	1,4785469	1,123654	1,457896	1,412569
P	0,7456986	0,002356	0,4125699	0,147852	0,456987	0,145698
f-crit(0,05;31;31)=1,6222123 t-crit(0,05;62)=1,63598						

This means that if the same teacher taught in any other class of the basic set with the same multimedia teaching tool like in the experimental one, then the pupils would with a 95% probability reflect motivational inputs caused by this MTA in the same way and with the same score difference of the MOT variable like the students of the superior set. The assumption about a significant difference in the motivational effect of the teacher who used MTA was confirmed by a statistical analysis.

The research results confirmed the assumptions summarized in the hypothesis 1. There we claimed that the motivational effect of a teacher on students will be significantly stronger in those groups in which the teacher uses MTA, than in those in which he does not do so. The hypothesis has been supported. Its validity can be generalized on a basic set of pupils of the chosen basic schools.

Conclusion

A computer in teaching brings a lot of positives but also negatives. Teaching with the use of a computer and multimedia teaching aids bring teachers and students much more fun while teaching and learning and the overall effectiveness of teaching with a qualified use highly exceeds traditional forms of teaching. Using MTA while teaching Technology requires intensive work with modern technologies and it is connected with a certain risk, which is always present during the use of computing technology. Despite these findings we support the claim that even the most elaborate teaching content, the latest textbooks and technology in schools will not change the course, level, quality and effectiveness of teaching if behind all these there does not stand a timeless, highly reliable and creative teacher.

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